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ABSTRACT

This paper describes the general rationale, hypotheses, methodology, findings and implications of a recent dissertation research project conducted in the Columbus, Ohio, public schools. The computer-based study investigated the simultaneous relationship between achievement in microeconomics and attitude toward economics, level of computer anxiety, and attitude toward learning. Twelfth-grade students (n=155) in regular social science courses at four Columbus senior high schools were randomly assigned to alternative instructional treatments. Each treatment, emphasizing either a problem-oriented strategy or a rule-oriented strategy, consisted of a week-long computer-based unit teaching fundamental economic concepts and principles of supply, demand, and equilibrium. Pre-, post-, and delayed-post measures were given, and appropriate data analyses completed. Results of these analyses indicate that individuals receiving problem-oriented instruction performed at a higher level on all of the cognitive achievement scales, although this difference was significant only for questions on the lower-order subscale of Posttest I. There is also evidence that a problem-oriented strategy may positively influence attitudes towards economics, as well as the degree of sophistication towards economic issues generally. (32 references) (Author)

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SECONDARY COMPUTER-BASED INSTRUCTION IN MICROECONOMICS: COGNITIVE AND AFFECTIVE ISSUES

Final Report

Presented to the Annual Meeting of the Association for
Educational Communications and Technolgy
January 1989
Dallas, Texas

By

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SECONDARY COMPUTER-BASED INSTRUCTION IN MICROECONOMICS: COGNITIVE AND AFFECTIVE ISSUES

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Abstract

This paper describes the general rationale, hypotheses, methodology, findings and implications in a recent dissertation research project conducted in the Columbus, Ohio, public schools. The computer-based study investigated the simultaneous relationship between achievement in microeconomics and attitude toward economics, level of computer anxiety, and attitude toward learning. Twelfth-grade students in regular social science courses (n=155) at four Columbus senior high schools were randomly assigned to two alternative instructional treatments. Each treatment, emphasizing either a problem-oriented strategy or a rule-oriented strategy, consisted of a week-long computer-based unit teaching fundamental economic concepts and principles of supply, demand, and equilibrium. Pre, post and delayed-post measures were given, and appropriate data analyses completed. Results of these analyses indicate that individuals receiving problem-oriented instruction performed at a higher level on all of the cognitive achievement scales, although this difference was significant only for questions on the lower-order subscale of Posttest I. There is also evidence that a problem-oriented strategy may positively influence attitudes towards economics, as well as the degree of sophistication towards economic issues generally.

INTRODUCTION

During the last fifteen years, the microcomputer has emerged as a dynamic, rapidly-evolving medium of instruction (Hall, 1982, 1978). Moreover, rigorous research into computer-based instruction (including interactive videodisc, hypermedia, and compact-disc technologies) has had a significant impact on the entire field of educational research, most noticeably in the study of individual differences in learning and the integration and application of a diversity of theories of concept learning, knowledge representation, and instructional design (Kearsley, Hunter, & Seidel, 1983). Evidence suggests that advanced technologies can be used to improve: (1) the rate of learning (Kulik, Bangert, & Williams, 1983); (2) the degree of learning achievement (Chambers & Bork, 1983); (3) the attitudes of students towards computers (Magidson, 1978); and (4) the motivation and interest in the learning experience (Kearsley, et al., 1983).

Also during this period, the development of curriculum and instruction in pre-college economic education has become increasingly important and widespread throughout the public schools of the United States (Walstad & Watts, 1985). In estimating the effects of various programs on student economic learning, most evaluation studies have only measured cognitive outcomes while often neglecting to measure affective learning and individual differences (Soper & Walstad, 1983). No studies have attempted to design and apply research-based microcomputer instruction in economics while analyzing the simultaneous relationship between achievement in microeconomics and attitude toward economics, level of computer anxiety, and attitude toward learning. The purpose of this study was to begin to address this problem, and to acquire a broader understanding of the complexity involved in the development of economics education courseware and concept learning in economics, as well as gain a deeper insight into the phenomenon of learning economics from computers across both cognitive and affective domains.

The rationale for this study was based on the emergence of two important phenomenon in educational theory and practice: (a) the systematic design, development and widespread implementation of computer-based instructional courseware in public school and commercial training curricula, and (b) the parallel development of the field of economic education and continuing research into the relationship between the affective and cognitive factors related to improving economic education across the academic curriculum. In particular, critical gaps in the literature existed in the design and evaluation of precollege computer-based instructional strategies in microeconomics and the investigation of the relationship between achievement in microeconomics concepts and attitude towards economics, economic attitude sophistication, level of computer anxiety, and attitude towards learning.

Problem-Oriented Instruction

Cognitive theories that broadly synthesize instruction and generative learning collectively argue that changes in behavior occur as a result of learning, and that learners construct meaning as they approach new content domains (Shuell, 1986; Wittrock, 1978, 1974). Cognitive-designed instructional systems encourage the learner to use heuristics, strategic tools and procedural knowledge during the process of concept acquisition and problem-solving (diSessa, 1977; Nickerson et al., 1985). Computer-based learning environments designed from a cognitive, problem-oriented model may facilitate the individual's ability to explore his or her thinking processes, deal with ambiguity, recognize underlying assumptions, and search for commonalities among data (Perkins, 1986). A basic rationale for the study was that exploratory research into both the structure and effectiveness of emerging technology-based problem-oriented strategies to teach specific subjects and knowledge domains is essential if such systems are to prove useful in addressing long-term instructional needs.

The underlying rationale of a "problem-oriented" pedagogy is that instruction can foster meaningful learning by emphasizing relationship and connectivity between information, concepts and principles within a relevant context (i.e., a problem scenario). Structuring the content around engaging, interactive problem scenarios, a "problem-oriented" adaptation of Reigeluth's Elaboration Theory (Reigeluth, 1983) approach to instructional design emphasizes the following elements: (1) early ideas in an instructional sequence should epitomize rather than summarize concepts, with the superordinate principles introduced first as the "glue" that provides the conscious framework for all subordinate concepts that are to follow; (2) specific cognitive strategies, analogies and models are both explicitly taught and embedded within the sequence, and provide flexible tools with which to approach problems within the domain; (3) concepts and principles are then synthesized through new applications

which require increasingly sophisticated analyses and applications of the learned strategic skills and concepts; and (4) knowledge within a sequence is only then summarized before proceeding to a deeper level within the central, superordinate principle (an elaboration consisting of a more advanced epitome and complex problem). These specific considerations underlie the rationale of the experimental problem-oriented treatment in this study.

Rule-Oriented Instruction

Behavioral theories have been extensively applied to the new technologies of instruction, and have been the foundation upon which much of conventional computer courseware has been designed. These theories collectively argue that changes in behavior are learned, and that learners associate correct responses to stimuli in their environment as they approach new content domains (Skinner, 1954, 1958; Amsel, 1960). While the view of thinking as an operant learned response predated B.F. Skinner, the major catalyst in applying behavioral theory to programmed instruction in "learning machines" was the linear frame-based approach of Skinner (Lumsdaine, 1960). The deductive, step-by-step sequencing of Skinner's instructional strategy emphasizes unambiguous, impersonal, rote rule-example-recall sequences, followed by immediate reinforcement after a correct response (Merill & Tennyson, 1977; Scandura, 1964). Computer-based learning environments designed from a behavioral, rule-oriented model emphasize the following elements: (1) the function of the tasks is to deliver and provide practice in the comprehension of given rules and concepts within the content domain; (2) the tasks foster direct concept acquisition by presenting explicit, well-defined rules with multiple examples to illustrate and reinforce previously stated definitions of terms and principles; and (3) concepts and principles are organized in a consistent, predefined, linear, hierarchical sequence, with the broader, most comprehensive principle learned last, and only after all previous material has been delivered and learning systematically evaluated (i.e., mastery). These specific considerations underlie the rationale of the experimental rule-oriented treatment in this study.

Economic Education

The teaching of economic principles, knowledge and reasoning has become an integral part of the core curriculum in American schools across all grade levels K-12 (Clark & Barron, 1981; Walstad & Watts, 1985). The Joint Council on Economic Education has supported the development of computer courseware, film series, and other media to provide students with the economic understanding and problem-solving ability needed to deal with both personal and societal economic issues (Morton et al., 1985; Soper & Walstad, 1983; Walstad, 1979). There is a growing need for the improvement of economic education throughout the curriculum, and therefore research that investigated the interrelationship between achievement in economics and attitudes towards economics and learning would contribute to the continuing development in mediated instructional strategies in economics education, and may have additional implications to the teaching of thinking and problem-solving across many other content domains (Heiman & Slomianko, 1987; Nickerson, et al., 1985).

It was hypothesized that the problem-oriented courseware would result in greater cognitive achievement in microeconomics on the overall measures (i.e., total score on each of the pre, post, and delayed posttests), and on the higher-order and lower-order question subscales. Also, it was believed that problem-oriented instruction would result in greater long-term retention of the conceptual knowledge, while individuals expressing a deep approach towards learning, a more positive attitude towards economics, and lower computer anxiety would perform higher on the cognitive measures of achievement. Finally, previous research in economic education supported the hypothesized higher cognitive achievement performance, and more "sophisticated" and positive attitudes towards economics for male subjects (Lumsden & Scott, 1987).

Major Research Issues

The study examined numerous questions related to the teaching and acquisition of conceptual knowledge in microeconomics via problem-oriented and rule-oriented computer-based instructional strategies on the secondary education level. The ten alternative research hypotheses, while providing a logical structure to the investigation, were not themselves the conceptual focus of the study.

The principal educational problems addressed in the study included the following areas of inquiry:

1) The effect of rule-oriented and problem-oriented strategies on the acquisition and retention of basic conceptual knowledge in microeconomics;

2) The differential effect of the two instructional approaches on learning and cognition as measured by the higher-order and lower-order question levels of the achievement instruments;

3) The relationship between attitude toward economics and economic attitude sophistication in a microeconomics principles lesson unit;

4) The less understood factor of computer-related anxiety in relation to precollege learning from computer-based instruction;

5) Exploratory knowledge into the deep versus surface approach towards learning dichotomy, particularly in relation to instruction in a subject matter unfamiliar to students;

6) The factor of student gender as interrelated to the other research issues stated in this section;

7) The interaction of the factors noted above in relation to learning in a computer-based economics principles unit;

METHODS

An experimental pretest/posttest study design was conceived to empirically explore a complex array of questions and issues related to computer-based instruction in microeconomics. In analyzing the relative efficacy of two alternative instructional strategies (a rule-oriented and a problem-oriented strategy), 155 senior high school students from four Columbus, Ohio secondary schools participated during the final data collection. These two strategies were broadly derived from the competing pedagogical orientations of the respective behavioral and cognitive schools of psychology and learning theory. Two computer-based lesson units, each designed to reflect operational versions of the rule or problem instructional strategy were designed to teach selected microeconomics concepts over an intensive five-day period in microcomputer laboratories located at each of the four site schools. In addition to the treatment variable, gender was also investigated as a factor in both attitudes and learning.

The treatments were delivered in similar self-contained computer laboratories within each school, on Apple IIe microcomputers equipped with either color or monochrome monitors, and with one student assigned per computer workstation. Each rule-oriented and problem-oriented courseware treatment sequence included five full class periods for lesson modules (i.e., including drill, tutorial, and simulation components), in addition to five class periods used for pre and post-instruction data collection procedures.

A battery of cognitive and affective instruments were used to evaluate the differential effects of the courseware treatments on both student achievement and attitudes, including Pretest ($r=.50$), Posttest I ($r=.76$) and delayed Posttest II ($r=.62$) repeated measures. Three parallel-form instruments, composed of equal

numbers of higher and lower-order level questions, were constructed from items selected and modified from several nationally-normed tests including the Test of Economic Literacy and the Test of Understanding in College Economics. Categorization of all achievement questions into higher and lower levels, in addition to obtaining content validity and representativeness, was corroborated by a juror of qualified individuals. In addition, the Survey on Economic Attitudes and the Computer Anxiety Index described earlier were used to examine student attitudes towards economics and level of computer anxiety, respectively. The third attitude measure, the Learning Attitude Survey, was developed to investigate the relationship between general approach towards learning and other factors in the study. Item analysis data further supported the reliability of these instruments.

Parallel form cognitive achievement instruments were each systematically developed with moderate to good reliability, strong content validity, and two subscales representing higher-order and lower-order levels of cognitive processing (Bloom et al., 1956). Three existing affective indexes were obtained that measured attitude towards economics (ATE) as a subject, the degree of economic attitude sophistication (EAS) in a general understanding of the market system, and attitude toward computer technology (CAIN) indicating relative level of computer anxiety. A fourth index (DEEP) was developed locally to measure the relative depth of a student's general approach towards new learning tasks and subject matters.

The effect of the rule-oriented and problem-oriented computer-based instructional strategies on teaching microeconomics concepts was investigated using a variety of statistical analytic techniques including the paired t-Test, univariate and factorial analysis of variance, Chi Square, and multiple linear regression. Cognitive achievement was measured with a 34-item multiple-choice pretest, immediate posttest (Posttest I), and a delayed posttest delivered after a two-week interval for retention effects (Posttest II).

The four affective measures (ATE, EAS, CAIN and DEEP) were randomly administered in the pretest phase while all four were included in a questionnaire battery given in the posttest phase. The data on these affective measures were scored using two different coding schemes (a straight 6-point Likert scale and a 16-point certainty estimate scale), although only data derived from the certainty coding scheme was eventually included in the definitive analyses.

Affective Issues

Three areas of interest in the affective domain were investigated in this study: (1) student attitude toward economics; (2) degree of computer anxiety; and (3) student approach or attitude toward learning. Each of these three topics applied six-point Likert-type inventories, and are discussed briefly in the following section.

Attitude Toward Economics

The nationally-normed Survey on Economic Attitudes was used to address this need (Soper & Walstad, 1987). This instrument consists of two subscales, the ATE (i.e., Attitude Toward Economics; r=.88), a general attitudinal measure toward economics as a subject area, and the EAS (i.e., Economic Attitude Sophistication; r=.66), comprised of statements reflecting views on specific economic issues, and measuring the degree of sophistication in the student's general understanding of the market system. Together, these scales provided a reasonably comprehensive measure of student attitude toward economics.

Computer Anxiety

The nationally-normed Computer Anxiety Index (Maurer, 1983; r=.94), a measure of generalized anxiety towards the computer, was applied to investigate collateral problems associated with instructional computer usage. Generally,

student populations tend to be positive/normally distributed, indicating a general acceptance and absence of any specific fear of computer technology by the majority of population. A small but significant group of individuals tend to exhibit considerably higher computer anxiety than the norm, however, and so it is valuable to include this factor in computer-based educational research projects.

Attitude Toward Learning

In addition, a special questionnaire, the Learning Attitude Survey;r=.45), was developed locally to measure students' general approach towards learning. A surface approach was characterized by instrumentalism, extrinsic motivation, performing learning tasks as means to other ends, memorization of new material, and student concern over the length of time the learning task would take. A deep approach towards learning was characterized by interest in the material itself, intrinsic motivation, relating new information to previous knowledge, inductive and exploratory reasoning during a learning task, and a personalization of the new knowledge (Biggs & Rihn, 1984). The "deep approach towards learning" subscale proved to be highly reliable (DEEP r=.82), and was used in a broader analysis of attitude-related factors.

Experimental Treatment

Rule-Oriented Lesson Set

In the rule-oriented lesson set, the general instructional sequence used a combined drill and tutorial-based approach, proceeding through the presentation of concepts and questions delivered within the context of explicit expository and inquisitory instruction (Allen, 1986; Merrill, 1983; Merrill & Tennyson, 1977). The strategy consisted of (a) a series of information presentations, (b) rule-recall questions, and (c) rule-example/non-example-instance instructional sequences teaching knowledge of the major principles and concepts in microeconomic theory. Brief review and overview sections began each lesson module to maintain the continuity between lessons. Supply and demand were introduced as the fundamental components of the market system, while equilibrium was presented as the superordinate concept between supply and demand. Subsequent expository and inquisitory sequences required application of the previous content and an increasingly complex set of well-defined economic rules that were both explicitly taught and exemplified throughout the lessons.

A rule as viewed here is a knowledge representation of some event or object (e.g., economic supply) consisting of a name and corresponding definition classifying the behavior or structure of the event or object (Merrill & Tennyson, 1977). Hence the term rule-oriented refers to the technique of (a) employing superordinate and subordinate concept names and definitions presented initially with critical and variable attributes (expository generalities), (b) presenting and contrasting examples and non-examples (expository instances), (c) frequent questioning on the rules and concepts names and definitions (inquisitory generalities, including direct recall questions); and (d) questioning newly encountered examples (inquisitory instances) to augment student understanding concepts within a logical and unambiguous rule hierarchy. Learning the rule definitions thus promotes a deeper understanding of the change relationships of supply, demand, and equilibrium.

The rule-oriented lesson set consisted of the five program diskettes. Following the introduction, the initial concept sequence began. The general instructional sequence followed a consistent series: (a) first, an advanced organizing preview and review segment prepared the learner for the current lesson, (b) the subsequent presentation of a rule name and definition (expository generality; the initial presentation of the definition included the critical and variable attributes of the concept), (c) a recall question on the preceding rule name and definition (inquisitory generality), (d) a set of paired examples and non-examples in tabular form and brief descriptions of an economic

situation which served to illustrate and discriminate the rule clearly (expository instance), (e) a question on the preceding material using an example not encountered previously, and (f) a summarizing restatement of the newly acquired concept name and definition. This basic sequence was reiterated throughout each lesson disk. All questions included informing the learner of results and supplying the correct answer if the learner was unsuccessful after the second attempt. A summative review, including the presentation of rule tables listing each previously learned concept and followed by a mastery series of 8-10 questions concluded each lesson.

Problem-Oriented Lesson Set

In the problem-oriented lesson set, the general instructional sequence employed a role-playing simulation of an imaginary business, proceeding through the presentation of concepts and questions embedded within the context of problem scenarios and events. The lesson set consisted of a series of situations emphasizing application and analysis level knowledge of the major principles and change relationships in microeconomic theory. Brief review and overview sections began each lesson module to maintain the continuity between lessons. Equilibrium, the superordinate concept, was presented initially and consistently as a unifying construct between supply and demand. Subsequent problem situations required application of the student's growing knowledge and a specific cognitive strategy: the "Graphic Method." This cognitive strategy was both explicitly taught and repeatedly embedded throughout the lessons to guide students in hypothesis generation and testing concerning changing behavior within the simulated market system. Hence the term problem-oriented refers to the technique of employing problem situations as the core to understanding concepts operationally, and in using a context-specific problem-solving strategy, the Graphic Method, to resolve the problem by predicting the outcome based upon market changes in supply and demand.

The Problem Scenario. The student is placed in the role of the owner and chief executive officer of a new business. At the same time the computer tutor component of the program plays the role of a professional consulting firm (Microbiz Associates) for young companies similar to the one the student is now operating. The idea is broadly to establish a friendly working relationship between the "consulting firm" tutor and the student "manager" in the course of operating the new business successfully.

The student is requested to invent both a product and a company name. The student enters these names into the program and they are subsequently presented within each problem situation, feedback elaboration and remediation segments of that particular courseware program. Various motivational frames appear throughout the lesson to encourage the student manager to become interested in the profit-making capabilities of his or her own business enterprise. The explicit suggestion is made that profit will be enhanced by correct decision-making during the business operation cycle. (each lesson represents a corporate 3-month quarter).

The new company begins in full production of the chosen good or service. The new student manager is periodically presented with simulated electronic mail business reports sent from the Microbiz firm. The content of each report is a simulated problem situation, each describing a set of particular events requiring the immediate attention of the business manager. These on-line reports include text, supply and demand schedules, and graphs of supply and demand curves. The manager is then required to predict the effect of the economic changes in the determinants of supply and demand on the new equilibrium price and quantity of his or her product. At the conclusion of each program, a synthesizing review is presented over the concepts emphasized during the recent "business quarter". At the conclusion of the lesson set, a summative evaluation of student performance in terms of "profit points" is presented.

RESULTS

In summary, several trends can be identified from the results. First, the main effect of treatment was statistically significant in only one case that indicated the marginal superiority of the problem-oriented subjects on the lower-order subscale of Posttest I. Gender main effects on the cognitive performance measures were not found, although several gender-related trends were observed including the consistently superior performance of males on all cognitive variables and a significantly higher ATE reported among the male subjects.

Concerning the measurement of economic attitudes, ATE was positively related to cognitive performance, with superior achievement related to higher ATE. The results generally confirm the findings of Soper & Walstad (1987, 1988) that a moderately positive association exists between the constructs of attitude toward economics and economic attitude sophistication. Moreover, the combination of ATE and EAS appear strongly related to superior cognitive performance only when both are "High". Higher performers have High ATE/High EAS combinations in most cases, while lower performers tend to report Low ATE/High EAS or High ATE/Low EAS.

Concerning the interaction of CAIN and DEEP, another trend appears for: higher performers report Low DEEP/Low Anxiety, while lower performers report High DEEP and High Anxiety and CAIN score is inversely related to cognitive achievement: the lower the computer anxiety reported, the higher/better the cognitive performance (on most measures).

Result Summary

1) Subjects in the problem-oriented treatment group consistently outscored their rule-oriented counterparts on most cognitive outcome measures including the overall score and lower-order subscale score of Posttest I and II, and the higher-order score of Posttest I. This superior cognitive achievement was statistically significant (p = .045) as a main effect only in the lower-order subscale of Posttest I, however.

2) Mean scores of Male subjects were greater than female subjects on all cognitive measures, including the overall score and both higher and lower-order subscale score on Posttest I and II. Importantly, none of these differences was significant.

3) None of the ATE or EAS main effect differences was statistically significant for any cognitive measure including the overall score and both higher and lower-order subscale score on Posttest I and II.

4) A significant disordinal interaction was observed between ATE and EAS on the overall Posttest I score (p = .017). Subjects in the High ATE/High EAS group outscored all other subjects, and this mean difference was greatest between High ATE/High EAS and: (a) the High ATE/Low EAS group (3.00 points) and (b) the Low ATE/High EAS group (2.34 points). Both differences are considered important from a practical perspective.

5) A disordinal interaction between ATE and EAS on the higher-order subscale of Posttest I was observed in which subjects in the High ATE/High EAS group outscored all other groups (p = .022). A similar disordinal interaction between ATE and EAS was also observed in relation to mean performance on the lower-order subscale of Posttest I (p = .045). Again, subjects in the High

ATE/High EAS group outscored all other groups. Greatest difference in mean performance was between the High ATE/High EAS group and the High ATE/Low EAS group (1.20 points), similar to the results for the Posttest I overall and higher-order scores.

6) A disordinal interaction between ATE and EAS was shown in relation to mean performance on the lower-order subscale of Posttest II (p = .025). The result in this case was consistent with the other significant interactions noted above in summary paragraphs 4 and 5: subjects in the High ATE/High EAS group outscored all subjects on the lower-order subscale of Posttest II, with the greatest difference in mean performance observed between the High ATE/High EAS group and the Low ATE/High EAS group (1.70 points).

7) No statistically significant differences could be demonstrated for the overall score main effects of the computer anxiety variable (CAIN), although evidence was presented indicating a trend toward superior performance by subjects in the lower anxiety group on the overall performance means of both Posttest I and II. In the case of Posttest I, the difference was 1.32 points; for Posttest II the corresponding difference was 1.18 points.

8) Significant main effects differences were reported for the computer anxiety variable (CAIN) on the higher-order subscale of Posttest I and the lower-order subscale of Posttest II, respectively. The trend for superior performance (1.10 points) by subjects in the Low Anxiety group was observed on the higher-order subscale performance means of Posttest I (p = .027). For Posttest II, the difference between High and Low anxiety subjects was significant only for the lower-order subscale means (p = .063).

9) No statistically significant differences could be demonstrated for the overall score main effects of the deep approach towards learning variable (DEEP). However, a surprising trend of superior test performance by subjects in the Low DEEP group over subjects in the High DEEP approach group was observed in the overall performance means of both Posttest I and II (1.25 and 0.34 points, respectively).

10) A significant main effect for the deep approach toward learning variable was reported only in the case of the lower-order subscale of Posttest I. Similar to the trend observed in summary paragraph 9, subjects in the Low DEEP group scored higher than their counterparts in the High DEEP group by 0.95 points (p = .054).

11) The ordinal interaction of treatment and EAS on the lower-order subscale of Posttest I indicated the superior performance of subjects in the problem-oriented group in both Low and High EAS conditions. The treatment variable (TREAT) here indicated a main effect result (p = .050). The largest difference was observed between problem-oriented and rule-oriented subjects on the High EAS level (1.70 points), indicating a potentially beneficial relationship between learners with High EAS and problem-oriented instruction in economics.

12) Results for the disordinal interaction of treatment and EAS on the lower-order subscale of Posttest II are the reverse of the previous finding for Posttest I (See summary paragraph 11 above and also Figures 6 and 7). While the treatment variable was not itself significant (treatment was significant in the Posttest I case), the disordinal interaction between treatment and EAS was much more pronounced (p = .006). The greatest difference between means (1.80 points) was between problem-oriented (7.00 points) and rule-oriented (5.50 points) groups in the Low EAS category. This situation was reversed in the High EAS category with subjects in the rule-oriented group outscoring subjects in the problem-oriented group by 0.80 points.

13) A disordinal interaction was found between level of treatment and CAIN score for the lower-order subscale of Posttest II (p = .023). While subscale mean performance remained relatively consistent across problem-oriented subjects in either High and Low computer anxiety categories, rule-oriented treatment group performance changed noticeably across the Low to High Anxiety dichotomy. Although Low Anxiety subjects in the rule-oriented treatment outscored all groups, their Higher Anxietyrule-orientedcounterparts scored considerably lower (1.90 points lower mean score), showing the largest difference between any two groups. Problem-oriented subjects in the High Anxiety group achieved superior performance over the High Anxiety rule-oriented subjects by 1.40 points. The importance of the computer anxiety variable is demonstrated by the main effect result (p = .084).

14) A disordinal interaction of ATE and DEEP on the higher-order subscale of Posttest II was reported (p = .080). While High DEEP subjects outscored all groups, the High DEEP/High ATE subjects scored lower than Low ATE/High DEEP (0.70 points) and High ATE/Low Deep (0.50 points). The largest difference between groups (1.00 point) occurred between the High DEEP and Low DEEP subjects in the Low ATE category.

15) A significant three-way interaction was observed between treatment, ATE and EAS on the higher-order subscale of Posttest II (p = .058). Highest scorers were in the problem-oriented treatment in the High ATE/Low EAS category, while lowest scorers were in the problem-oriented treatment in the Low ATE/Low EAS category (Means = 6.00 and 4.37, respectively). This particular mean difference (1.63 points) suggests that High ATE is more important than EAS as a factor in cognitive performance. However, although High ATE is influential, especially in combination with Low EAS, where EAS is high for both groups, ATE was not as salient on the higher-order questions of Posttest II.

16) Highest scorers on the overall Posttest I mean were male subjects in the High ATE/High EAS category (Mean = 16.95) while lowest scorers were female subjects in the High ATE/Low EAS group (Mean = 12.95). Although this 4-point difference was very significant from a practical view, the gender x ATE x EAS interaction was not statistically significant on the overall Posttest I. The ATE x EAS interaction was

itself significant, however (p = .015). Males and females performed at the same level when both were in the High ATE/Low EAS category. Also, the relationship between higher ATE and High EAS attitudes in economics cognitive achievement was more pronounced in the male subjects.

17) A significant interaction was observed between gender, ATE and EAS on the lower-order subscale of Posttest I (p = .082). Highest scorers (Mean = 9.06) were males reporting Low ATE/Low EAS, while lowest scorers (Mean = 6.91) were males reporting High ATE/Low EAS. This is the converse of the expected relationship and performance outcomes.

18) The three-way interaction of gender x ATE x EAS approached significance on the overall Posttest II score (p = .124). Highest scorers were females in the High ATE/High EAS group (Mean = 12.56), while lowest scorers were females in the Low ATE/High EAS group (Mean = 9.62), a 2.91 point difference. This result supports the role of High ATE in superior retention performance.

19) Although not statistically significant, the interaction of gender, ATE and EAS on the lower-order subscale of Posttest II also corroborated the importance of ATE in relation to cognitive performance outcomes (p = .163). The widest difference was between female subjects in the High ATE/High EAS group and females in the Low ATE/High EAS group (Means = 7.31 and 4.69, respectively).

20) A significant interaction was reported between treatment, computer anxiety and DEEP on the overall Posttest II score (p = .076). Highest scorers were subjects in the rule-oriented treatment group with Low DEEP/Low Anxiety (Mean = 14.00), while lowest scorers were rule-oriented treatment subjects with Low DEEP/High Anxiety (Mean = 10.15), a mean difference of 3.85 points. Treatment groups were closest when rule-oriented treatment subjects were Low DEEP/Low Anxiety and when problem-oriented treatment subjects were Low DEEP/Low Anxiety (Means = 11.14 and 11.25, respectively). This finding supports the importance of the CAIN measure, and the consistent superior cognitive performance in this computer-based study of subjects with lower computer anxiety.

21) A significant interaction was also reported between treatment, computer anxiety and DEEP on the lower-order subscale of Posttest II (p = .076). Highest scorers were subjects in the rule-oriented treatment with Low DEEP/Low Anxiety (Mean = 8.27), while lowest scorers were rule-oriented treatment subjects with Low DEEP/High Anxiety (Mean = 5.15), a mean difference of 3.12 points. In all mean comparisons within the High Anxiety group, the problem-oriented treatment group outscored the rule-oriented treatment subjects, and this superiority was clearest when both treatment groups were in the Low DEEP category (Means = 7.04 and 5.15, respectively). The finding again supports the

importance of the CAIN measure and the consistently superior performance of subjects with lower computer anxiety. The computer anxiety factor, however, appears to have been less salient for subjects in the problem-oriented treatment.

22) A significant three-way interaction was observed between gender, computer anxiety and DEEP on the Posttest I higher-order subscale (p = .052). Highest scorers in this case were males in the High DEEP/Low Anxiety group, while lowest scorers were males in the High DEEP/High Anxiety group (Means = 8.20 and 5.27, respectively). The difference here of 2.93 points corroborates other findings of the value of the CAIN measure. A second important difference was seen between females in the Low DEEP category reporting High Anxiety (Mean = 5.54) and those reporting Low Anxiety Mean = 7.28), a 1.74 mean difference.

23) A significant three-way interaction was observed between gender, computer anxiety and ATE on the Posttest I lower-order subscale (p = .044). Highest scorers in this case were males in the High ATE/Low Anxiety group, while lowest scorers were males in the High ATE/High Anxiety group (Means = 9.13 and 7.14, respectively). This result again demonstrates the salience of the CAIN measures in studies involving computer-based instruction in economics.

24) A series of hierarchical multiple regression analyses were performed. Apart from the inclusion of the treatment variable (p = .045), the DEEP score (p = .046) and to some degree the CAIN score (p = .089) on the lower-order subscale of Posttest I, no other statistically significant regression findings involving the primary independent variables were observed. The application of Pretest and Posttest I variables as regressors was successful on all scales (p = .000 in each case), confirming that (a) the use of pretest scores in the case of an immediate posttest (DV), and (b) both pretest and immediate posttest scores in the case of a delayed posttest (DV) are reliable in explaining the variance of their respective dependent variables.

CONCLUSION

Findings indicate there may be potential benefits of employing problem-oriented strategies in computer courseware teaching basic concepts in microeconomics. While a problem-oriented strategy may not result in a significantly superior level of concept acquisition compared to a conventional rule-oriented strategy, there is evidence that problem-oriented courseware may positively influence student attitude towards economics, as well as students' degree of sophistication towards economic issues about the market system in general. As technology-based problem-oriented environments become increasingly powerful and dynamic, increased benefits in cognitive achievement, and in particular in positive affective changes, may be observed in the long term. However, high-quality rule-oriented strategies, however, are apparently both adequate and equally effective for certain learners (i.e., with a surface approach toward learning) and certain learning tasks with well-defined content domains. The single most "effective" strategy may require some optimal hybrid combination of problem and rule approaches, or other instructional

theories and techniques. Future research investigating the application of instructional technologies to secondary content areas should de-emphasize the gross comparison of strategies and short-term outcomes and systematically disaggregate specific individual difference factors in the study of long-term curricular implementation of various instructional strategies.

REFERENCES

Amsel, A. (1960). Error responses and reinforcement schedules in self-instructional devices. In A.A. Lumsdaine and R. Glaser (Eds.), Teaching machines and programmed learning. Washington, D.C.: National Education Association.

Becker, W.E., & Walstad, W.B. (Eds.). (1987). Econometric modeling in economic education research. Boston, Massachusetts: Kluwer Nijhoff Publishing.

Biggs, J.B., & Rihn, B.A. (1984). The effects ofintervention on deep and surface approaches tolearning. In J.R. Kirby (Ed.), Cognitive strategies and educational performance. Orlando, Florida: Academic Press.

Chambers, J.A., & Bork, A. (1980). Computer-assisted learning in the U.S. secondary/elementary schools. N.Y.: Association for Computing Machinery.

Clark, J.R., & Barron, D.D. (1981). Major findings of the national survey of economic education. Journal of Economic Education, 12(2), 45-51.

diSessa, A.A. (1977). On "learnable" representations of knowledge: A meaning for the computational metaphor. AI Memo, Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, MA.: ED 207 588.

Gagne, R.M. (1987). Instructional technology: Foundations. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Hall, K.A. (1982). Computer-based education. In H. Mitzel (Ed.), The Encyclopedia of Educational Research. Fifth Edition. N.Y.: Free Press.

Hall, K.A. (1978). Computer-based education: Research, theory, and development. EducationalCommunications and Technology Journal, 10, 1-7.

Heiman, M., & Slomianko, J. (Eds.). (1987). Thinking skills instruction: Concepts and techniques. Washington, D.C.: National Education Association.

Kearsley, G., Hunter, B., & Seidel, R.J. (1983). Two decades of computer-based instruction projects: What have we learned? T.H.E. Journal, 10(4), 88-96.

Kulik, J.A., Bangert, R.L., & Williams, G.W. (1983). Effects of computer-based teaching on secondary school students. Journal of Educational Psychology,75, 19-26.

Lumsdaine, A.A. (1960). Some issues concerning devices and programs for automated learning. In A.A. Lumsdaine & R. Glaser, (Eds.), Teaching machines and programmed learning. Washington, D.C.:National Education Association.

Lumsden, K.G., & Scott, A. (1987). The economics student reexamined: Male-female differences in comprehension. Journal of Economic Education, 18(4), 365-375.

Magidson, E.M. (1978). Issue overview: Trends in computer-assisted instruction. Educational Technology, 18(4), 5-8.

Martin, B.L., & Briggs, L.J. (1986). The affective and cognitive domains: Integration for instructionand research. Englewood Cliffs, N.J.: Educational Technology Publications.

Maurer, M.M. (1983). Development and validation of a measure of computer anxiety. Unpublished Master's Thesis, Iowa State University, Ames, Iowa.

Merrill, M.D., & Tennyson, R.D. (1977). Teaching concepts: An instructional design guide. Englewood Cliffs, New Jersey: Educational Technology Publications.

Morton, J.S., Buckles, S.G., Miller, S.L., Nelson, D.M.& Prehn, E.C. (1985). Master Curriculum Guide in Economics: Teaching Strategies/High School Economics Courses. New York, N.Y.: Joint Council on Economic Education.

Nickerson, R.S., Perkins, D.N., & Smith, E.E. (1985). The teaching of thinking. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Perkins, D.N. (1986). Knowledge as design. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Reigeluth, C.M. (1983). The elaboration theory of instruction. In C.M. Reigeluth, (Ed.) Instructional design theories and models. Hillsdale, N.J.:Lawrence Erlbaum Associates.

Scandura, J.M. (1964). An analysis of expository and discovery modes of problem solving instruction. Journal of Experimental Education, 33, 149-159.

Shuell, T.J. (1986). Cognitive conceptions of learning. Review of Educational Research, 36 (4),411-436.

Shulman, L.S., & Keislar, E.R., (Eds.). (1966). Learning by discovery: A critical appraisal. Chicago: Rand McNally.

Skinner, B.F. (1958). Teaching machines. Science, 128, 969-977.

Skinner, B.F. (1954). The science of learning and the art of learning. Harvard Educational Review, 24(2),86-97.

Soper, J.C., & Walstad, W.B. (1987). Test of Economic Literacy 2: Discussion guide and rationale. N.Y.: Joint Council on Economic Education.

Soper, J.C., & Walstad, W.B. (1983). On measuring economic attitudes. Journal of Economic Education, 14(4),

Walstad, W.B. (1979). Effectiveness of a USMES in-service economic education program for elementary school teachers. Journal of Economic Education, 11(1), 1-12.

Walstad, W.B., & Watts, M. (1985). Teaching economics in the schools: A review of survey findings. Journalof Economic Education, 16(2), 135-146.

Wittrock, M.C. (1974). Learning as a generative process. Educational Psychologist, 11, 87-95.Wittrock, M.C. (1978). The cognitive movement in instruction. Educational Psychologist, 13, 15-29.

Note: Complete ANOVA and regression summary data tables, as well as copies of the instrumentation and microcomputer courseware can be obtained by writing to the author at 2333 Neil Avenue, Columbus, OH 43202.